Find the other values the same way. Here is a compact way to arrange your work.

$$f(g(1)) = f(5) = 0$$
$$f(g2)) = f(3) = 6$$
$$f(g(3)) = f(2) = 4$$
$$f(g(4)) = f(1) = 3$$
$$f(g(5)) = f(7), \text{ which does not exist}$$
$$f(g(6)) = f(4) = 2$$

b. $g(f(2)) = g(4) = 1$, which is not the same as $f(g(2)) = 6$

Note that in order to find a value of a composite function such as $f(g(x))$, the value of $g(x)$ must be in the domain of the outside function, f. Because $g(5) = 7$ in Example 2 and there is no value for $f(7)$, the value of $f(g(5))$ is undefined.

Composite Functions from Equations

Example 3 shows you how to find values of a composite function if you know the equations of the two functions.

EXAMPLE 3 ➤ Let f be the linear function $f(x) = 3x + 5$, and let g be the exponential function $g(x) = 2^x$.

a. Find $f(g(4))$, $f(g(0))$, and $f(g(-1))$.

b. Find $g(f(-1))$ and show that it is not the same as $f(g(-1))$.

c. Find an equation for $h(x) = f(g(x))$ explicitly in terms of x. Show that $h(4)$ agrees with the value you found for $f(g(4))$.

SOLUTION **a.** $g(4) = 2^4 = 16$, and $f(16) = 3 \cdot 16 + 5 = 53$, so $f(g(4)) = 53$

Writing the same steps more compactly for the other two values of x gives

$$f(g(0)) = f(2^0) = f(1) = 3 \cdot 1 + 5 = 8$$
$$f(g(-1)) = f(2^{-1}) = f(0.5) = 3(0.5) + 5 = 6.5$$

b. $g(f(-1)) = g(3 \cdot -1 + 5) = g(2) = 2^2 = 4$, which does not equal 6.5 from part a

c. $h(x) = f(g(x)) = f(2^x) = 3 \cdot 2^x + 5$

The equation is $h(x) = 3 \cdot 2^x + 5$.

So $h(4) = 3 \cdot 2^4 + 5 = 3 \cdot 16 + 5 = 53$, which agrees with part a.

Example 4 shows you that you can compose a function with itself or compose more than two functions.